Regression Analysis of Nursing Home Cost Report Data

The results presented on the following pages describe the analysis conducted to explore what factors have a significant impact on Total Profit Margin of Massachusetts nursing facilities.

Using 1999 nursing facility cost report data, bivariate analyses were run to examine the influence of each of 22 variables individually on Total Profit Margin. The sample size included 457 nursing facilities.

In Table 1, R^2 represents the level of variation in the dependent variable (Total Profit Margin) caused by variation in each single independent variable. The order of independent variables in Table 1 is based on the magnitude of R^2. The absolute value of T statistic indicates the likelihood that the independent variable has a statistically significant impact on the dependent variable. The sign of the T statistic shows the direction of the impact of an independent variable. The probability column in Table 1 directly measures the level of statistical significance of an independent variable. Since we chose 0.05 as the threshold, a factor does not have a statistically significant impact on the dependent variable if its probability is larger than 0.05.

Table 1 shows that among 22 factors, 14 independent variables have a statistically significant impact on Total Profit Margin in a one-to-one relationship.

Table 1 Bivariate Analyses: Total Profit Margin as Dependent Variable

Independent Variable	R^2	T-statistic	Probability
Occupancy Rate	*0.2468*	*12.21*	*<.0001*
Claimed Expenses per Patient Day	*0.1012*	*-7.16*	*<.0001*
Nursing Expenses per Patient Day	*0.1002*	*-7.12*	*<.0001*
Total Expenses per Patient Day	*0.0708*	*-5.89*	*<.0001*
% Private Revenue	*0.0577*	*5.28*	*<.0001*
Administrative Expenses per Patient Day	*0.0526*	*-5.03*	*<.0001*
% Private Patients	*0.0419*	*4.46*	*<.0001*
Medical Service Expenses per Patient Day	*0.0283*	*-3.64*	*0.0003*
% Medicaid Patients	*0.0269*	*-3.55*	*0.0004*
Fixed Expenses per Patient Day	*0.0220*	*-3.20*	*0.0015*
Average MMQ Score	*0.0215*	*3.15*	*0.0017*
% Medicaid Revenue	*0.0199*	*-3.04*	*0.0025*
Total Patient Days	*0.0158*	*2.71*	*0.0071*
Total Capital Expense per Patient Day	*0.0122*	*-2.37*	*0.0180*
% Medicare Revenue	0.0072	-1.82	0.0690
Weighted Medicaid Rate	0.0070	1.77	0.0780
DPH Report Card Score	0.0072	1.71	0.0889
Not for Profit	0.0014	-0.80	0.4239
Age of Plant	0.0005	0.46	0.6488
% Medicare Patients	0.0003	-0.40	0.6866
Total Number of Beds	0.0001	0.26	0.7984
Total Nursing Hours per Patient Day	0.0000	-0.09	0.9268

Attempts were made to derive estimates for operating margin, total margin using only claimed expenses, and total margin excluding acquisition-related capital costs. However, since the cost report data does not distinguish between operating and non-operating revenues, nor does it facilitate the identification of acquisition-related costs, accurate estimates for these variables were not determinable.

The next step in the analysis was to run a multivariate regression model. Variables were included regardless of their relationship in the bivariate analysis. In cases where one variable was a component of another (nursing expense is a component of total cost), the smaller component was included instead of the larger aggregate variable. In cases where two variables were collinear or highly correlated to each other, the variable with the higher predictive value was chosen. (A bigger R^2 or a bigger absolute value of T statistic). For example, although both % Private Revenue and % Medicaid revenue have a statistically significant impact on Total Profit Margin, they are highly correlated to each other. Since % Private Revenue has a higher predictive value than % Medicaid, the former was included and the latter was excluded from the model.

The results in Table 2 show that five of the ten variables included in the multivariate regression model have a statistically significant impact on Total Profit Margin. The Beta scores in Table 2 allow one to compare the relative importance of the impact of the predictors on the dependent variable. The larger the absolute value, the greater the impact on the dependent variable. The order of the variables in table 2 is based on Beta score, which is consistent with the orders of T statistic and probability. According to the calculations, occupancy rate is the most significant variable and, as a result, has the highest predictive value in determining total margin.

Table 2 Multivariate Regression: An Extended Model

R^2 = .369			
Independent Variable	**T-statistic**	**Probability**	**Beta Score**
Occupancy Rate	*8.63*	*<.0001*	*.3756*
Nursing Expenses per Patient Day	*-5.43*	*<.0001*	*-.2359*
% Private Revenue	*4.30*	*<.0001*	*.1811*
Administrative Expenses per Patient Day	*-4.25*	*<.0001*	*-.1724*
Average MMQ Score	*2.07*	*0.0392*	*.0824*
Total Patient Days	1.86	0.0636	.0809
Nursing Hours per Patient Day	1.30	0.1935	.0542
Not for Profit	-0.79	0.4323	-.0322
Number of Deficiencies in 99 Survey	-0.79	0.4323	-.0311
Age of Plant	0.20	0.8444	.0079

The model was then refined to include the five variables listed in Table 2 as having a statistically significant relationship with total margin. The refined model included calculations to determine the elasticity of each variable in addition to the predictive value. Elasticity is an expression of how much change in the dependent variable is influenced by a 1% change in the independent variable. (e.g. if occupancy rate increases by 1%, how much will total margin change?). In many respects, elasticity provides information similar to that found in the beta scores. Due to the nature of the model and the mathematical permutations required by the calculations, the elasticity values presented here represent absolute values. The absolute values still allow one to compare

the relative impact of each of the variables. As in the first multivariate model, occupancy rate has the greatest influence on total profit margin.

Table 3 Multivariate Regression: The Final Model

$R^2 = .367$				
Independent Variable	**T-statistic**	**Probability**	**Beta Score**	**Elasticity (absolute value)**
Occupancy Rate	9.66	<.0001	0.3928	0.229
Nursing Expenses per Patient Day	-5.47	<.0001	-0.2235	0.068
% Private Revenue	4.66	<.0001	0.1864	0.022
Administrative Expenses per Patient Day	-4.55	<.0001	-0.1788	0.037
Average MMQ Score	2.25	0.0249	0.0862	0.030

Given that Medicaid is the primary payer for the majority of nursing facility residents, % Medicaid Revenue was included in place of % Private Revenue for the sake of comparison. The message in the results did not change, and the results are presented in Table 4.

Table 4 Multivariate Regression: The Final Model with % Medicaid Revenue

$R^2 = .355$				
Independent Variable	**T-statistic**	**Probability**	**Beta Score**	**Elasticity (absolute value)**
Occupancy Rate	9.80	<.0001	0.4027	0.249
Nursing Expenses per Patient Day	-5.46	<.0001	-0.2303	0.059
Administrative Expenses per Patient Day	-4.62	<.0001	-0.1845	0.037
% Medicaid Revenue	-3.67	0.0003	-0.1536	0.016
Average MMQ Score	2.50	0.0129	0.0970	0.038